

What is claimed is:

- 1 1. A remote copy system which copies data between a
- 2 plurality of storage systems, comprising:
  - 3 a first storage system comprising a first primary volume;
  - 4 a second storage system comprising a second primary
  - 5 volume;
  - 6 a network apparatus which is coupled to a host computer,
  - 7 said first storage system and said second storage system, and
  - 8 which controls a path for accessing from said host computer to
  - 9 said first primary volume and a path for accessing from said host
  - 10 computer to said second primary volume; and
  - 11 a third storage system which is coupled to said first
  - 12 storage system and said second storage system, and which
  - 13 comprises a secondary volume;
- 14 wherein:
  - 15 said first storage system stores data received from the host
  - 16 computer into said first primary volume, and sends the data
  - 17 stored in said first primary volume to said third storage system
  - 18 through a network;
  - 19 said third storage system stores the data received from
  - 20 said first storage system into said secondary volume; and
  - 21 when the data stored in said first primary volume is
  - 22 migrated to said second primary volume,
  - 23 said network apparatus transfers an access request issued
  - 24 from the host computer and destined to said first primary volume,
  - 25 to said second primary volume,

26           said second storage system receives, from said first storage  
27  system, management information for identifying data to send to  
28  said third storage system,

29           said second storage system stores write data received from  
30  the host computer and the data received from said first storage  
31  system and stored in said first primary volume, into said second  
32  primary volume, and sends data determined based on said  
33  management information out of the data stored in said second  
34  primary volume, to said third storage system, and

35           said third storage system stores the data received from  
36  said second storage system, into said secondary volume.

1  2.       A remote copy system according to Claim 1, wherein:  
2           according to an instruction from a management terminal,  
3  said network apparatus converts access target identification  
4  information included in the access request received from the host  
5  computer into identification information of said second primary  
6  volume, and sends the converted access request to said second  
7  storage system; and

8           according to an instruction from said management  
9  terminal, said second storage system receives the data stored in  
10 said first primary volume from said first storage system and  
11 stores the received data to said second primary volume, and sends  
12 the data stored in said second primary volume to said third  
13 storage system.

1  3.       A remote copy system according to Claim 1, wherein:  
2           the management information, which said second storage

3 system receives from said first storage system, further includes  
4 information managing write order of data written by the host  
5 computer; and

6 said second storage system uses said information  
7 managing write order to manage write order of the write data  
8 received from the host computer.

1 4. A remote copy system according to Claim 1, wherein:  
2 until, out of data written to said first primary volume,  
3 data to be stored into said secondary volume has been completely  
4 transferred, said third storage system receives said data from said  
5 first storage system and stores said data into said secondary  
6 volume.

1 5. A remote copy system according to Claim 4, wherein:  
2 until, out of data written to said first primary volume,  
3 data to be stored into said secondary volume has been completely  
4 transferred, said third storage system receives said data from said  
5 first storage system to store said data into said secondary volume,  
6 and also receives said data which said second storage system is  
7 received from the host computer, from said second storage system  
8 to store said data into said secondary volume.

1 6. A remote copy system according to Claim 5, wherein:  
2 data received by said third storage system from said first  
3 storage system or from said second storage system is given with a  
4 sequence number; and  
5 said third storage system stores data received from said

6 first storage system or from said second storage system, in order  
7 of sequence numbers, into said secondary volume.

1 7. A remote copy system according to Claim 6, wherein:  
2 said management information, which said second storage  
3 system receives from said first storage system, further includes a  
4 sequence number whose value is larger by one, than a newest  
5 sequence number given to data that said first storage system  
6 receives from the host computer; and

7 said second storage system gives sequence numbers to  
8 write data received from the host computer, with an initial value  
9 of said sequence numbers being the sequence number included in  
10 the management information received from said first storage  
11 system.

1 8. A remote copy system which copies data between a  
2 plurality of storage systems, comprising:

3 a host computer;

4 a first storage system comprising a first primary volume;

5 a second storage system comprising a second primary  
6 volume; and

7 a third storage system which is coupled to said first  
8 storage system and said second storage system, and which  
9 comprises a secondary volume;

10 wherein:

11 said first storage system stores data received from the host  
12 computer into said first primary volume, and sends the data  
13 stored in said first primary volume to said third storage system

14 through a network;

15        said third storage system stores the data received from  
16 said first storage system into said secondary volume; and

17        when the data stored in said first primary volume is  
18 migrated to said second primary volume,

19        said host computer sends a write request issued from an  
20 application program executed by the host computer and destined  
21 to a primary volume, to said second primary volume of said second  
22 storage system,

23        said second storage system receives, from said first storage  
24 system, management information for identifying data to send to  
25 said third storage system,

26        said second storage system stores write data received from  
27 the host computer and the data received from said first storage  
28 system and stored in said first primary volume, into said second  
29 primary volume, and sends data determined based on said  
30 management information out of the data stored in said second  
31 primary volume, to said third storage system, and

32        said third storage system stores the data received from  
33 said second storage system, into said secondary volume.

1 9.       A remote copy system for copying data between a plurality  
2 of storage systems, comprising:

3        a first storage system comprising a first primary volume;

4        a second storage system comprising a second primary  
5 volume;

6        a management apparatus that connects said first storage  
7 system and said second storage system to a host computer; and

8           a second storage system comprising a secondary volume;  
9   wherein:

10           said first storage system stores data received from the host  
11   computer into said first primary volume, and sends the data  
12   stored in said first primary volume to said second storage system  
13   through a network;

14           said second storage system stores the data received from  
15   said first storage system into said secondary volume; and

16           when the data stored in said first primary volume is  
17   migrated to said second primary volume,

18           said management apparatus sends an access request  
19   received from the host computer and destined to a primary volume,  
20   to said second storage system,

21           said second storage subsystem receives, from said first  
22   storage subsystem, management information for identifying data  
23   to send to said second storage system,

24           said second storage system stores write data received from  
25   the host computer and the data received from said first storage  
26   system and stored in said first primary volume, into said second  
27   primary volume, and sends data determined based on said  
28   management information out of the data stored in said second  
29   primary volume, to said second storage system, and

30           said second storage system stores the data received from  
31   said first storage system, into said secondary volume.

1   10.   A computer program product for performing remote  
2   copying between a plurality of storage systems, said computer  
3   program product comprising:

4           a code that a first storage system having a first primary  
5 volume stores write data received from a host computer into said  
6 first primary volume;

7           a code that said first storage system sends said write data  
8 to a third storage system having a secondary volume through a  
9 network;

10          a code that said third storage system stores said write  
11 data received from said first storage system into said secondary  
12 volume, when data stored in said first primary volume is migrated  
13 to a second volume owned by a second storage system;

14          a write request transfer code that a write request  
15 generated by the host computer and destined to a primary volume  
16 is transferred to said second storage system;

17          a code that said first storage system sends management  
18 information for identifying data to send to said third storage  
19 system, to said second storage system;

20          a code that said first storage system sends data stored in  
21 said first primary volume to said second storage system;

22          a code that said second storage system stores write data  
23 received from the host computer and data received from said first  
24 storage system, into said second primary volume;

25          a code that said second storage system sends data  
26 identified based on said management information, out of data  
27 stored in said second primary volume, to said third storage  
28 system; and

29          a code that said third storage system stores the data  
30 received from said second storage system;

31          a computer readable storage medium for storing the codes.

1 11. A computer program product according to Claim 10,  
2 wherein:

3       said write request transfer code comprises a code that a  
4 volume associated with primary volume identification information  
5 included in the write request generated by the host computer is  
6 changed from said first primary volume to said second primary  
7 volume.

1 12. A computer program product according to Claim 11,  
2 wherein:

3       said write request transfer code is stored in a memory of a  
4 network apparatus coupled to said first storage system, said  
5 second storage system and the host computer; and

6       said network apparatus executes said write request  
7 transfer code, to send the write request, which is received from  
8 the host computer, to said second primary volume that is  
9 associated with the primary volume identification information  
10 included in the write request.

1 13. A computer program product according to Claim 10,  
2 wherein:

3       said write request transfer code is stored in a memory of  
4 the host computer, and comprises a code according to which a  
5 write request from an application program executed by the host  
6 computer is controlled to be sent to said second storage system.

1 14. A computer program product according to Claim 10,  
2 wherein:

3           said management information sent from said first storage  
4   system to said second storage system further includes information  
5   for managing write order of data written by the host computer;  
6   and

7           said computer program product further comprises a code  
8   that said second storage system uses said information managing  
9   write order, which is received from said first storage system, to  
10   manage write order of write data received from the host computer.

1   15.   A computer program product according to Claim 10,  
2   further comprising:

3           a code that, until, out of data written to said first primary  
4   volume, data to be stored into said secondary volume has been  
5   completely transferred, said third storage system receives said  
6   data from said first storage system and stores said data into said  
7   secondary volume.

1   16.   A computer program product according to Claim 10,  
2   further comprising:

3           a code that, until, out of data written to said first primary  
4   volume, data to be stored into said secondary volume has been  
5   completely transferred, said third storage system receives said  
6   data from said first storage system and stores said data into said  
7   secondary volume, and also receives data that is received by said  
8   second storage system from the host computer, from said second  
9   storage system and stores said data into said secondary volume.

1   17.   A computer program product according to Claim 15,  
2   wherein:

3           data received by said third storage system from said first  
4 storage system or said second storage system is given with a  
5 sequence number; and

6           and said program product further comprises a code that  
7 said third storage system stores data received from said first  
8 storage system or said second storage system, in order of sequence  
9 numbers, into said secondary volume.

1 18. A computer program product according to Claim 17,  
2 wherein:

3           said management information, which said second storage  
4 system receives from said first storage system, further includes a  
5 sequence number whose value is larger by one, than a newest  
6 sequence number given to data that said first storage system  
7 receives from the host computer; and

8           said program product further comprises a code that said  
9 second storage system gives sequence numbers to write data  
10 received from the host computer, with an initial value of said  
11 sequence numbers being the sequence number included in the  
12 management information received from said first storage system,  
13 and sends said write data to said third storage system.